SEPARATION AND/OR SEQUESTRATION APPARATUS AND METHODS

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority to U.S. Provisional Patent Application No. 61/589,704 which was filed on Jan. 23, 2012, the entirety of which is incorporated by reference herein.

STATEMENT AS TO RIGHTS TO INVENTION MADE UNDER FEDERALLY-SPONSORED RESEARCH AND DEVELOPMENT

This invention was made with Government support under Contract DE-AC05-76RL01830 awarded by the U.S. Department of Energy. The Government has certain rights in the invention.

TECHNICAL FIELD

The present disclosure relates to the separation of components from a stream of different components. The stream can be combustion effluent which can include CO_2 for example, and the apparatus and methods can be used to separate and/or sequester CO_2.

BACKGROUND

Environmental policy has dictated that certain components of combustion effluents be regulated and their discharge into the atmosphere be reduced. Example effluents include but are not limited to SO_x and NO_x. Recently, environmental public policy considerations have dictated that the current or expanding amounts of CO_2 exhaust into the atmosphere should be limited or eliminated as well. As CO_2 is a major product of combustion, and combustion is typically an essential method for creating energy and meeting the world's energy demands, the focus of limiting CO_2 emissions has been on combustion processes such as coal combustion, particularly, flue gas from coal combustion. Flue gas typically contains coal combustion products which include components such as sulfur, nitrogen, and carbon, as well as oxides of same, including CO_2. The present disclosure provides apparatus and methods for separating the CO_2 from the other flue gas components and post separation, the sequestration of the CO_2.

SUMMARY OF DISCLOSURE

Apparatus for separating CO_2 from an electrolyte solution are provided. Example apparatus can include: a vessel defining an interior volume and configured to house an electrolyte solution; an input conduit in fluid communication with the interior volume and configured to convey the electrolyte solution to the interior volume; an output conduit in fluid communication with the interior volume and configured to convey the electrolyte solution outside the interior volume; an exhaust conduit in fluid communication with the interior volume; and an anode located within the interior volume and configured to provide hydrogen to the electrolyte solution within the vessel.

Other example apparatus can include: an elongated vessel defining an interior volume and configured to house an electrolyte solution, the vessel having two regions, each of the two regions associated with an opposing terminal end of the vessel; an input conduit extending outwardly from a wall of the one region of the vessel and in fluid communication with one of the two regions and configured to convey the electrolyte solution to the one region; an output conduit extending outwardly from a wall of the other region of the vessel and in fluid communication with the other of the two regions and configured to convey the electrolyte solution outside the other region; an exhaust conduit in fluid communication with the one region; and an anode located within the one region and configured to provide hydrogen to the electrolyte solution within the vessel.

Methods for separating CO_2 from an electrolyte solution are provided. Example methods can include: providing a CO_2 rich electrolyte solution to a vessel containing an anode; and distributing hydrogen from the anode to acidify the electrolyte solution and evolve at least some of the CO_2 from the electrolyte solution to outside the vessel.

DRAWINGS

Embodiments of the disclosure are described below with reference to the following accompanying drawings.

FIG. **1** is a separation apparatus according to an embodiment.

FIG. **1**B is the separation apparatus of FIG. **1** detailing the flow of components in accordance with an example configuration.

FIGS. **2** and **2**A are portions of the separation apparatus of FIG. **1** according to an embodiment.

FIGS. **3** and **3**A are portions of the separation apparatus of FIG. **1** according to an embodiment.

FIG. **4** is an alternative embodiment of a separation apparatus according to an embodiment.

FIG. **5** depicts photographs of an example according to an experimental embodiment.

FIG. **6** depicts the results for experiment 1.

FIG. **7** depicts the results for experiment 2.

FIG. **8**A is a separation apparatus according to an embodiment.

FIG. **8**B is the separation apparatus of FIG. **5** detailing the flow of components in accordance with an example configuration.

FIG. **9** is a portion of the separation apparatus of FIG. **5** according to an embodiment.

DESCRIPTION

This disclosure is submitted in furtherance of the constitutional purposes of the U.S. Patent Laws "to promote the progress of science and useful arts" (Article 1, Section 8).

The separation and/or sequestration apparatus and/or methods of the present disclosure are described with reference to FIGS. **1-9**. Referring first to FIG. **1**, assembly **10** is provided that includes housing **11** containing a solution **12**. Housing **11** can be an inert housing such as stainless steel, for example, and be of sufficient composition to avoid corrosion as it would be exposed to solutions having both acidic and caustic pH's. Housing **11** can define a vessel having an interior volume and configured to house solution **12**. The vessel can be elongated and have opposing terminal ends.

Solution **12** within assembly **10** can be considered an electrolyte solution and can be primarily aqueous in nature. Solution **12** can have a high salt concentration sufficient to minimize ohmic losses due to ionic conduction between an anode and/or cathode within assembly **10**. This salt concentration can range between from about 1 molar to about 10 molar. The electrolyte can be prepared from many salts such as potassium, sodium, barium, calcium, lithium, and/or magnesium,